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PI MU EPSILON FRATERNITY, Syracuse University, Syracuse, N. Y. [1918, 271-273].

During the year 1918-19 there were forty-one members, of whom sixteen were faculty and graduates and twenty-five were undergraduates. The officers were: Director, Professor John L. Jones; vice-director, Professor Louis Lindsey; secretary, Gertrude Reynolds '19; treasurer, Donald F. Sears '20; librarian, Agnes Wilcox '20; executive committee, the above officers and Roy Horst '19, Helen De Long '19, Ora M. Tanner '19; scholarship committee, Professors Floyd F. Decker and William H. Metzler, Roy Horst '19, Ethel M. Hicks '19 and Lona Preston '19.

December 2, 1918: Outline of plan for the year. Discussion of mathematical magazines.

January 6, 1919: Report of the scholarship committee and election of new members.

January 27: Initiation of new members. "Rerating of regent's papers" by Professor Lindsey.

February 17: "The method of least squares" by Joseph Atwell '19; "An application of the binomial theorem" by William Start '19.

March 10: "Normals to conics" by Ora Tanner '19, Cornelia Tyler '19 and Bertha Adams '19.

March 31: "The planimeter and how to integrate by mechanical means" by Professor Street.

April 28: "Teaching graphs in high school" by Professor Lindsey.

May 12: Election of officers. Informal talks by the faculty and seniors.

May 14: Annual picnic.

May 26: Special meeting to vote on the establishment of a chapter at Ohio State University. (Note: A new chapter of Pi Mu Epsilon has been established at Ohio State University.)

PROBLEMS AND SOLUTIONS.

EDITED BY B. F. FINKEL AND OTTO DUNKEL.

Send all communications about Problems to **B. F. FINKEL**, Springfield, Mo.

PROBLEMS FOR SOLUTION.

2822. Proposed by A. M. HARDING, University of Arkansas.

Show that the sum of the series

$$1 + 3 \cdot 2 + 5 \cdot 2^2 + 7 \cdot 2^3 + \dots + (2n - 1)2^{n-1}$$

to n terms is $3 - 2^n + (n - 1)2^{n+1}$.

2823. Proposed by S. A. COREY, Des Moines, Iowa.

Let TQ and PR be diameters of a circle with center O . Bisect TO at X and draw PQ . On PQ erect the perpendicular XW and on PR , the perpendicular QV . Prove that $OX \cdot PV = PW \cdot PQ$.

2824. Proposed by G. Y. SOSNOW, Newark, N. J.

If n_1, n_2, n_3, n_4 be the lengths of the four normals and t_1, t_2, t_3 , the lengths of the three tangents drawn from any point to the semi-cubical parabola, $ay^2 = x^3$, then will $27n_1n_2n_3n_4 = at_1t_2t_3$. [From *Mathematical Tripos Examination*, Cambridge, England.]

2825. Proposed by the late L. G. WELD.

A ball, having a coefficient of resilience α , strikes a rigid plane surface, inclined at an angle θ from the horizontal, after falling through a height h . What is the distance from the first to the second point of impact with the plane?

2826. Proposed by ALBERT A. BENNETT, University of Texas.

As a standard form for a square non-singular symmetric matrix under certain transformations, may be taken the form in which only the elements in the secondary diagonal are different from zero, and each of these is equal to unity. Analogously, as a standard form for a square non-singular skew-symmetric matrix (and hence incidentally of even order), may be taken the form in which only the elements of the secondary diagonal are different from zero, while the half of these which are towards the upper right-hand corner are each minus one, and the remaining half towards the lower left-hand corner, are each plus one. Denote both of these standard matrices by N .

Give simple parallel proofs that if M be given as non-singular and symmetric or non-symmetric as the case may be, a matrix P exists such that, with the usual notation

$$M = PNP'.$$

2827. Proposed by B. F. FINKEL, Drury College.

Find the equation of the envelope of the system of circles inscribed in a triangle having a given base and a given altitude.

2828. Proposed by T. M. BLAKSLEE, Ames, Iowa.

On page 72 of R. B. Hayward's *The Algebra of Coplanar Vectors and Trigonometry* occurs the sentence: "It will be a good exercise for the student to show that $\cos(90^\circ/7) = \frac{1}{2}\sqrt{x_1}$, where x_1 is the greatest root of the equation,

$$x^3 - 7x^2 + 14x - 7 = 0."$$

(1) Do not merely verify but deduce the equation and find x_1 . (2) Deduce the x -equation (x_1, x_2, x_3, x_4 , the roots) such that its greatest root x_1 gives $\cos(90^\circ/9) = \cos 10^\circ = \frac{1}{2}\sqrt{x_1}$. (3) Of what angles are $\frac{1}{2}\sqrt{x_1}, \dots, \frac{1}{2}\sqrt{x_4}$, in (2), the cosines? Develop a method of writing out at once $\cos(nv)$ in terms of powers of $\cos v$ if these are given for $(n-1)v$ and $(n-2)v$. The same for $\sin(nv)$. (4) Use the results of (2) and (3) to find the number of degrees in a radian. Hence, find π from radian instead of radian from π as is usual.

SOLUTIONS OF PROBLEMS.**411 (Algebra) [1914, 121; 1919, 268, 459]. Proposed by V. M. SPUNAR, Chicago, Ill.**

Determine $x_1, x_2, x_3 \dots x_p$ from the equations:

$$\begin{array}{ccccccc} x_1 + x_2 & + x_3 & + \dots & + x_p & = a_0, \\ b_1 x_1 + b_2 x_2 & + b_3 x_3 & + \dots & + b_p x_p & = a_1, \\ b_1^2 x_1 + b_2^2 x_2 & + b_3^2 x_3 & + \dots & + b_p^2 x_p & = a_2, \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ b_1^{p-1} x_1 + b_2^{p-1} x_2 & + b_3^{p-1} x_3 & + \dots & + b_p^{p-1} x_p & = a_{p-1}. \end{array}$$

A solution has been sent in by P. J. DA CUNHA, University of Lisbon, Portugal, in which the analysis is very much the same as that previously printed, but he also considers the case when some of the b 's are equal. For example, if $p = 3$ and $b_1 = b_2 \geq b_3$, we must have

$$\begin{vmatrix} 1 & 1 & a_0 \\ b_1 & b_3 & a_1 \\ b_1^2 & b_3^2 & a_2 \end{vmatrix} = 0.$$

If this condition is satisfied, the expressions for x_1 and x_2 in the general solution take indeterminate forms, and there will be an infinite number of solutions given by

$$x_1 + x_2 = \frac{a_0 b_3 - a_1}{b_3 - b_1}, \quad x_3 = \frac{a_0 b_1 - a_1}{b_1 - b_3}.$$